

REQUIREMENT 15

DETAILED REQUIREMENTS FOR MAGNETIC DEVICES  
(INDUCTORS, TRANSFORMERS, AND COILS)

15. General. This section describes detailed requirements for a DPA of commonly used inductors, transformers, and coils (MIL-PRF-27, MIL-PRF-15305, MIL-PRF-21038, MIL-PRF-39010, MIL-PRF-83446). These requirements supplement the general requirements in section 4 and are based upon the requirements of MIL-STD-981. Examples of typical configuration sketches are included. When applicable, specification numbers or types are referenced to assist in identification. Pre-DPA tests, such as functional tests and solderability tests, are assumed to have been satisfied by normal inspection and testing and are therefore not addressed.

15.1 Magnetic devices, inductors, and transformers (MIL-STD-981). Typical devices are shown on figures 15-1 and 15-2.

15.1. Method.

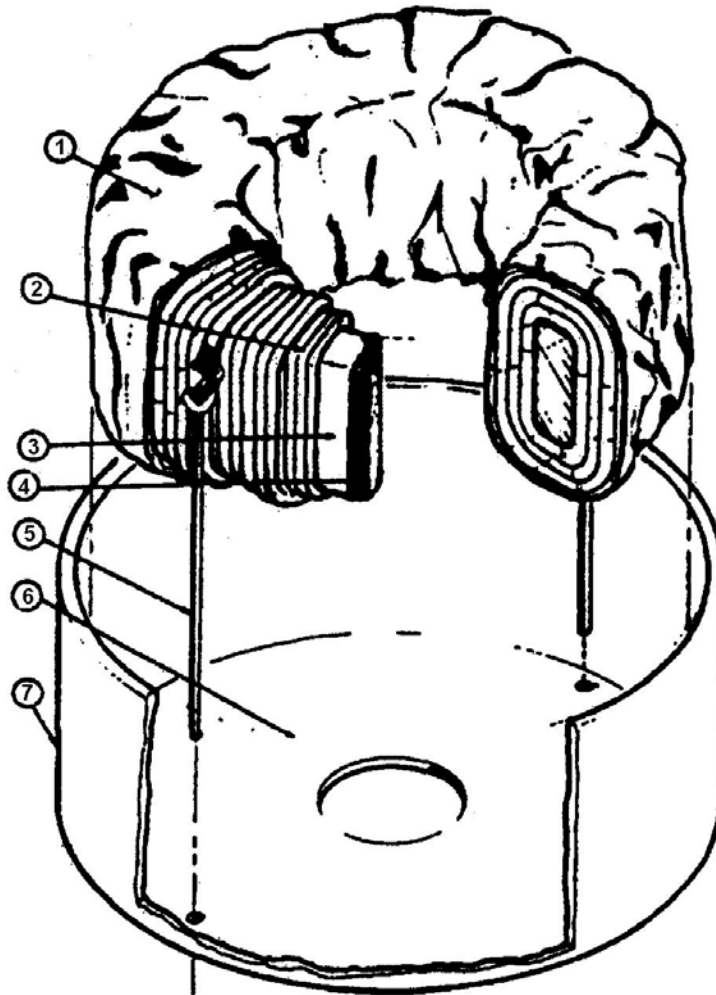
15.1.1.1 External visual. Perform visual inspection at 20X minimum magnification on all parts. Check for defects in leads, header, feed-through, and seal. Examine leads, surfaces, markings configuration, and dimensions. One photograph of one typical device showing all external markings shall be taken.

15.1.1.2 Hermeticity. Verify hermetic seal in accordance with the requirements of the part specification.

15.1.1.3 Radiographic inspection. Radiographs shall be taken of each device in each of three axes in accordance with appendix C of MIL-STD-981, unless radiographs that meet the product assurance program requirements of MIL-STD-981 are available from group A testing. The radiographic examination shall include, but not be limited to, inspection for foreign or extraneous materials, alignment, dimensions and clearances, configuration, and processing damage (ie. shrinkage cracks). Accept/reject criteria shall be in accordance with Appendix C in MIL-STD-981.

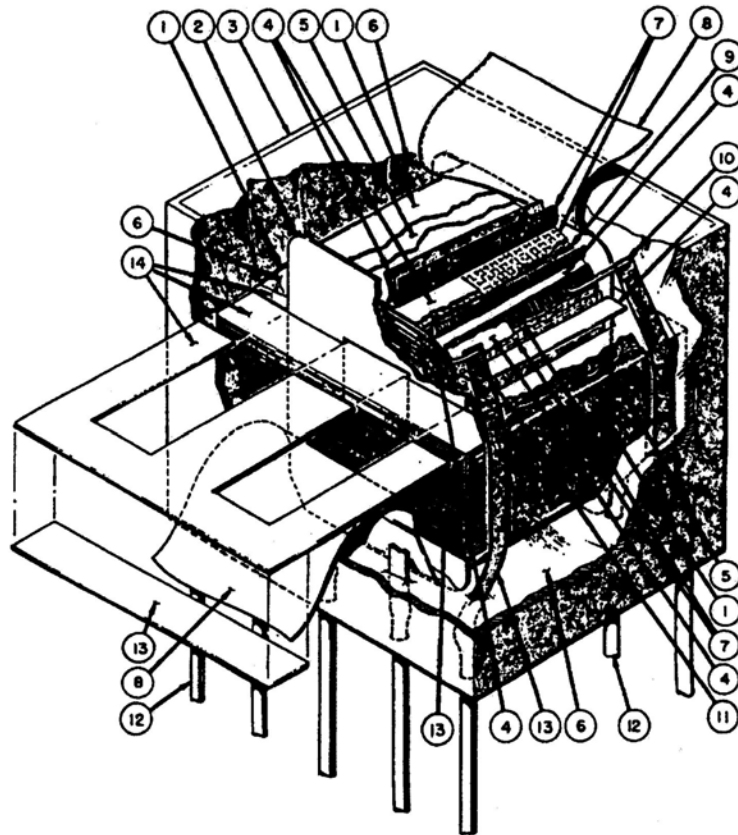
15.1.1.4 Disassembly. During the process of opening the enclosure, care must be exercised to assure external liquid, gaseous, particulate, or other contamination types do not enter the interior areas. All metal-cased inductors and transformers shall be decapped with a special can opener device. Do not unsolder devices as part of sample preparation. Half of the inductors or transformers (round up) shall be mechanically delidded or fully immersed in a suitable stripping solution to remove the encapsulating material as applicable. The stripping solution may be used either hot or cold, as applicable, provided that it does not damage the internal structure. When possible, remove encapsulation material in two steps. First expose terminations at the terminal leads or terminals; secondly, expose the terminations of the wound wire (magnet wire) to the interconnect lead (terminal lead). Carefully remove device from the potting cup and examine terminations, if any. Remove insulating cushion material from coil. Examine wire for nicks, scratches, etc., and examine internal solder joints.

15.1.1.5 Cross-sectioning. Encapsulate the remaining half of the devices in epoxy and cross-section in planes that will reveal the most useful data (typical terminal solder joints and core winding). Refer to radiographs for detail.



- |   |                                   |   |                            |
|---|-----------------------------------|---|----------------------------|
| 1 | Cushion Material (uncured teflon) | 5 | Interconnect and lead wire |
| 2 | Magnet wire                       | 6 | Potting level              |
| 3 | Core insulation                   | 7 | Potting cup (epoxy)        |
| 4 | Core                              |   |                            |

FIGURE 15-1. Inductor, power (typical).



- |         |                        |
|---------|------------------------|
| 1, 7, 8 | Tape                   |
| 2       | Bobbin                 |
| 3       | Plastic case           |
| 5       | Interlayer insulation  |
| 4, 5    | Potting material       |
| 6       | Magnet wire            |
| 9       | Interconnect/Wire weld |
| 10, 11  | Terminal lead          |
| 12      | E-1 laminations        |
| 13, 14  | E-1 laminations        |

FIGURE 15-2. Transformer (typical).

15.1.2 Data records. DPA findings that deviate from the specified configuration or other requirements or exhibit anomalies shall be documented as defects.

15.1.3 Visual examination. All exposed inner surfaces of each inductor shall be examined for the following characteristics at a minimum magnification of 30X (see figure 15-1 and 15-2). When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA samples exhibit any of the following anomalies:

- a. Wire size not in accordance with MIL-STD-981 and applicable specification or drawing.
- b. Interconnect ribbon not in accordance with applicable specification or drawing.
- c. Internal wire leads attached only by soldering with no evidence of mechanical anchoring.
- d. Wire windings that cross over other turns in going from one wound segment to adjacent segment.
- e. Nicks, kinks, reduction in wire cross-section, or evidence of other wire damage.
- f. Evidence of flux or other types of residues.
- g. Teflon tape.
- h. Charred, crushed, discolored, or damaged wire insulation.
- i. Repaired or spliced coil wire.
- j. Wire-to-lead termination connections that do not show a sufficient stress relief loop.
- k. Cold solder joints, or solder joints with no fillet around wire or termination.
- l. No evidence of weld tip indentation in welded joints.
- m. Cracks in welded joints.
- n. Loose or splattered weld.
- o. Lack of three full non-overlapping wraps of wire at each post termination.
- p. Stranded conductor wire at terminations that does not show pre-tinning or that shows large globules of solder that obscure the wire contour, or wire swelling due to excess wicking.
- q. Coils or other electronic components that show evidence of overheating.
- r. Fractures, cracks, or pinholes in solder joint.
- s. Solder joints with sharp tips or peaks or with a protruding, bare wire-end or bare strands of a conductor.
- t. Foreign or extraneous matter embedded in or adherent to wire joints, between windings, or cores.
- u. Thin impregnation <.005 inch.

15.2 Magnetic devices, RF coils. Typical devices are shown on figure 15-3.

15.2.1 Method.

15.2.1.1 External visual. Record all marking and identification that appears on the coil and its container and inspect for configuration compliance. Visually inspect each part at 20X minimum magnification for cracks, pinholes, or chips in the case material. Inspect the leads for evidence of physical damage (cuts, nicks, crushing), corrosion, or exposure of the base metal.

15.2.1.2 Terminal strength. Perform a lead pull strength test on two devices in accordance with the applicable specification requirements.

15.2.1.3 Decapsulation. Strip coating or case from one half of the number of samples in accordance with 15.1.1.4.

15.2.1.4 Coil examination. Examine depotted coil under 20X minimum magnification. Care shall be exercised when viewing the area where the magnet wire leaves the bobbin and goes to the solder joint at the lead wire.

15.2.1.5 Sectioning samples. Cast remaining half of samples in a suitable encapsulation media selected in accordance with EIA-469 and cross-section in a plane perpendicular to the lead plane to permit evaluation of material, internal design, construction, and workmanship. Extreme attention shall be paid to the area where the lead wire exits from the encapsulant.

15.2.2 Data records. DPA findings that deviate from the specified configuration or other requirements or exhibit anomalies shall be documented as defects.

15.2.2.1 Evaluation criteria. When the DPA is being conducted as a lot conformance test, the associated production lot shall be rejected if one or more of the DPA sample parts exhibit any of the defects listed below. Each defect shall be described and photographed for inclusion in the DPA report.

15.2.2.2 Visual examination. All inner surfaces of each coil shall be examined for the characteristics given in 15.1.3 herein, at a minimum magnification of 30X.

- a. Evidence of contamination, including flux and cleansing agents.
- b. Evidence of poor solder connection (no solder fillet or dewetting around wire or ribbon)
- c. Evidence of loose, cracked, or cold solder, or voids in the solder.
- d. Inadequate stress relief, bend or kink in wire, or improper interconnect wire to external lead (i.e., wire under tension).
- e. Nicks or reduction in wire diameter greater than 25 percent along the length of the wire and at the solder joint.
- f. Bobbin with cracks, chips, voids, discoloration, or distortion.
- g. Evidence of unprotected magnet wire or splicing of the wire.
- h. Evidence of poor winding on the bobbin or crossed wire turns.
- i. Improper shielding connections (if applicable).
- j. Wire size not in accordance with applicable procurement specification.
- k. No evidence of weld tip indentation on welded terminations.

1. Interconnect and lead wire
2. Solder
3. Encapsulant (Potting Material)
4. Coil Wire
5. Core
6. Adhesive (lead to core joint)

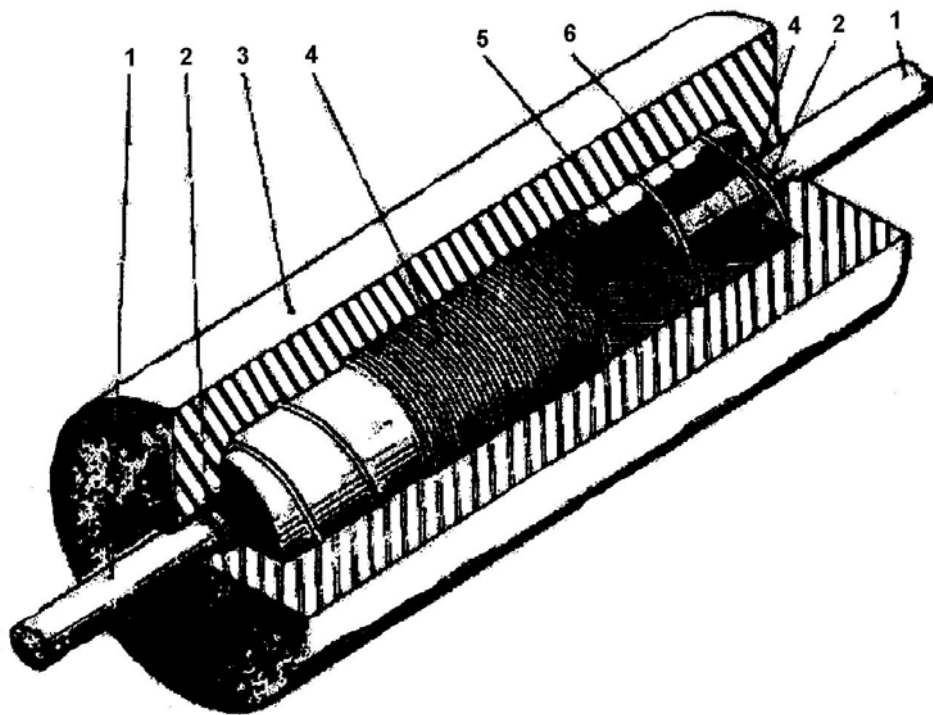


FIGURE 15-3. RF coil (typical).